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A BIOLOGICAL EVALUATION OF PROPOSED RECREATION SITES AT SOURGRASS AND MIDDLE FORK, STANISLAUS NATIONAL FOREST

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ABSTRACT

Proposed recreation areas at Sourgrass and Middle Fork were evaluated for pest problems which may affect management objectives for the sites. The major pest noted at both sites was western dwarf mistletoe on ponderosa pines. Other pests included western pine beetle, Armillaria root disease, red ring rot, and sugar pine scale at Sourgrass, and western pine beetle and Douglas-fir needle caste at Middle Fork. Annosus root disease and pine engravers are potential problems. Four management alternatives are discussed, including no pest management action, dwarf mistletoe management, root disease management, and vegetation management.

INTRODUCTION

While conducting a biological evaluation of Dardanelle Campground on the Summit Ranger District (reference 3430 Evaluation, Report No. 85-26, 1985), Bill Sistak, Forest Landscape Architect, asked us to examine proposed recreation sites at Sourgrass (Calaveras Ranger District) and Middle Fork (Groveland Ranger District). The purpose was to identify existing and potential pest situations at each site and to provide pest management alternatives for consideration by the Forest and the Districts during the planning and implementation of final plans for the sites.

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OBSERVATIONS

Sourgrass

The existing 2-acre Sourgrass Campground, located on the North Fork of the Stanislaus River at an elevation of 3800 feet, is overused to the point where the District feels that the visitors' level of enjoyment has been lowered. A proposal to improve the recreation experience by converting the existing campground to day-use and developing a 10-acre site directly across the River into a 30-to-50 unit campground is under consideration.

Vegetation at the 10-acre site consists of an overstory of ponderosa pine, some black oak, and minor amounts of sugar pine, incense-cedar, and white fir. Understory vegetation contains all of the above species, with scattered dense thickets of incense-cedar reproduction predominating in stand openings.

A number of pests were observed. The most significant was western dwarf mistletoe (Arceuthobium campylopodum) on ponderosa pine. The dwarf mistletoe was generally common on overstory pines, with infection levels varying from light to heavy. Dwarf mistltoe brooms were numerous. Light to moderate infection was also present in understory ponderosa pines.

Other pests, having relatively minor impact, were also noted. Evidence of western pine beetle (Dendroctonus brevicomis) attacks were found on several dead, small sawtimber-sized ponderosa pines in a densely-stocked pocket. Signs of Armillaria root disease (Armillaria sp.) and heavy dwarf mistletoe infection were present on the beetle-killed trees. Five living small sawtimber-sized ponderosa pines in the same area had numerous conks of the red ring rot fungus (Phellinus pini). Conks were associated with branch stubs throughout the length of the boles. Scattered sugar pine seedlings and saplings had branch flagging associated with scale (Matsucoccus sp.) infestations of needle fasicles.

Middle Fork

An Environmental Assessment, written in about 1983, suggested abandoning the existing Middle Fork Campground because of overuse. The EA further suggested developing a 60-acre abandoned Boy Scout Camp about 1/2 mile north of Middle Fork into a 200-unit campground (Diamond O Campground) as a replacement.

The Camp is located in a mixed conifer forest consisting mainly of ponderosa pine. Incense-cedar, sugar pine, and small amounts of Douglas-fir, white fir and black oak are also present. Some giant sequoia and coast redwood had been planted in the area of an existing lodge.

The most significant pest problem observed was western dwarf mistletoe on ponderosa pine. However, the observed infestation was limited to the relatively flat area around and north of the existing latrine building. Dwarf mistletoe was not observed further south in the area of the proposed campground units where site conditions were less rocky and a mixture of species was present.

Other pests observed included Douglas-fir needle cast (Rhabdocline weirii) on widely scattered Douglas-firs throughout the area, and western pine beetle on three dead pole-sized ponderosa pines. No pests were associated with dead incense-cedars along the edge of the meadow.

MANAGEMENT ALTERNATIVES

The following management alternatives are applicable throughout the two areas examined. Biologies of significant pests are given in the Appendix.

1. **No Pest Management Action.** Western dwarf mistletoe will continue to intensify in individual trees and continue to spread to adjacent susceptible ponderosa pines. The more heavily infected trees will become increasingly susceptibile to successful bark beetle attack because of overmaturity, overstocking, and compaction. Height growth and value of the understory pines as future replacement trees will be severely affected as they are annually exposed to additional dwarf mistetoe from the infected overstory.

Annosus root disease centers may develop as conifers are cut during development of the proposed campgrounds. As a consequence, premature conifer mortality will cause openings in the stands and hazardous trees. Cutting of oaks in the stand will provide a food base for Armillaria sp., with mortality of pine regeneration in the oak root zone resulting.

Current levels of overstocking combined with dwarf mistletoe infection in portions of the two sites and public use will have negative effects on the vegetation. These factors will increase tree stress and lead to successful bark beetle attacks.

2. **Dwarf Mistletoe Management.** Dwarf mistletoes can be controlled by silvicultural treatments, including eradication and suppression. Eradication, which would involve removing all infected hosts or all signs of infection, is probably not viable, or necessary, because of the mistletoe's occurrence throughout Sourgrass and in a large portion of Middle Fork.

Suppression of dwarf mistletoe involves reducing the effects of the disease to an acceptable level. Various tactics are available for removing dwarf mistletoe from recreation sites. Consideration of where dwarf mistletoe-infected trees are and of available management options during campground design and construction offers a unique opportunity to minimize future affects of the disease.

a. **Remove infected overstory trees to protect regeneration.** To prevent infection of understory trees, infected overstory trees need to be removed to reduce the source of inoculum. The understory can then be selectively thinned and pruned to remove dwarf mistletoe infections. Removal of large, heavily infected overstory trees would be easier now than after campground construction is completed.

b. **Encourage tree species diversity.** A mix of non-susceptible species in infested stands provides a barrier to spread of dwarf mistletoe. Maintaining and, if possible, increasing, the present species mix would reduce future impacts of the disease.

c. **Creat buffer strips.** Because dwarf mistletoe is currently confined to a specific area of the Middle Fork site, attempts to minimize its spread outward from the area of infestation could be made. Susceptible ponderosa pines should be removed from the margins of these infection centers and the regeneration of non-susceptible species favored.

d. **Pruning of infected branches.** Where dwarf mistletoe eradication is not possible and removal of the overstory source of infection cannot be accomplished, removing heavily-broomed branches can be beneficial. The purpose of this operation is to prolong the expected life of selected trees that have special value to the campground. Only the large witches' brooms, usually in the lower crown, would be pruned. High-value trees can be pruned of brooms in the lower crown if after removal of the brooms, the tree will still have a live-crown ration of 30% or more.

3. **Root Disease Management.** Although annosus and Armillaria root diseases are not present or of concern now in the undeveloped sites, they could have future impact if preventive measures are not considered during construction phases. The most effective control for annosus root disease is prevention. The probability of the formation of disease centers can be reduced by the application of borax (sodium tetraborate decahydrate, EPA Reg. No. 1624-94) to all freshly-cut conifer stumps (see FSM 3205, 2331.33, R-5 Supplement No. 90).

Killing of oaks should be avoided during construction phases. Armillaria spp. utilize oak stumps as a food base for the production and growth of rhizomorphs. Creating oak stumps will increase the probability of infection of conifers in the immediate vicinity of the oak roots. Cutting back young oaks and allowing them to sprout will decrease the available food base. Treating oaks so that they decline gradually rather than rapidly will also reduce the amount of food base available at any one time. In addition to minimizing the potential for an Armillaria problem, maintaining oaks in the stand would increase species diversity and would decrease impacts of annosus root disease and dwarf mistletoe.

4. **Vegetation Management.** Although pest management techniques are described above for individual pests, they will not be completely effective in reducing tree mortality and maintaining recreational values if implemented without considering vegetative health as the goal, rather than as pest control. The objective of any pest management activity in the proposed recreation areas should be to promote the growth of mixed species stands that are healthy and vigorous, all-aged, and properly stocked. A vegetation management plan for each site should be developed. These plans would include pest management considerations as well as condition of the vegetation and the recreation objectives.

Thinning dense aggregations of ponderosa pine at both sites will increase tree vigor and, at the same time, reduce potential impacts of successful western pine beetle attacks. Thinning would provide an opportunity to remove dwarf mistletoe-infected pines from the understory, red ring rot-infected pines at Sourgrass, and would increase species mix by providing openings for sugar pine and incense-cedar regeneration.

Conifer stumps created during construction phases or when thinning should be treated with borax to prevent F. annosus infection. Any actions that produce green pine slash should consider ways to minimize potential pine engraver beetle (Ips spp.) buildups. Treatments include limiting slash producing activities to early July through November, lopping and scattering slash in openings, piling and burning slash while green, or any other treatment that speeds the dessication of inner bark, removes the bark from the wood, or removes the green slash from the site.

When tree removal activities are undertaken, care must be taken to protect the residual trees from damage. This is especially important for white fir during falling and skidding. Basal wounds on true fir are entry courts for F. annosus. Wounding of residual white fir should be avoided to prevent subsequent decay. If a white fir is wounded, its removal during the operation should be considered because of the likelihood of decay and increased hazard potential.

The management strategies discussed previously for dwarf mistletoe and annosus rot disease should be integrated into the vegetation management plan. Implementation of such a plan will increase the lifespan of selected trees, reduce tree mortality and the number of hazard trees, provide for replacement trees, and improve the overall health and vigor of the stand.

APPENDIX

BIOLOGY OF PEST ORGANISMS

Following are summaries of the biology of diseases and insects that have the potential to adversely affect management objectives at Sourgrass and Middle Fork.

Western Dwarf Mistletoe

The dwarf mistletoes are serious forest diseases in much of the western United States, causing extensive growth loss and predisposing conifers to attack by bark beetles and other pathogens. Arceuthobium campylopodum, or western dwarf mistletoe, principally infects ponderosa and Jeffrey pines. Coulter and knobcone pines may be attacked when they grow in association with the principal hosts, while sugar pine and Douglas-fir are not susceptible.

Dwarf mistletoes are flowering plants that require a living host, from which they obtain most of their nutrients and all of their minerals and water. They spread by means of sticky seeds that are forcibly discharged from the plants in the fall, and adhere to whatever they contact. If a seed lands on a host needle or twig, it remains there over winter; the following spring it germinates, and the radicle penetrates the host. The parasite develops a root-like system in the inner bark and outer sapwood, and produces aerial shoots within 2-4 years after initial infection. Another 2-4 years elapse before seed are produced.

The spread of dwarf mistletoe is limited to the distance the seed travel, which from overstory to understory is usually 20-60 feet; with the aid of wind, seed may be carried as far as 100 feet. A rule of thumb is that dwarf mistletoes can spread a horizontal distance equal to the height of the plants in an infected tree. Because of various limits to spread and the long life cycle, the actual spread rate through an even-aged stand is usually 1-2 feet per year. Vertical spread through a tree crown is about 3-4 inches per year.

The impact of dwarf mistletoe is influenced significantly by host vigor; slow-growing trees succumb more rapidly than thrifty ones, and dense, stagnated stands are especially vulnerable. A. campylopodum often causes witches' brooms (abnormal proliferations of twigs that appear as clustered masses of foliage); these are usually most pronounced in the lower branches, and eventually lead to the decline of the upper crown.

Armillaria Root Disease

Several species of Armillaria are widely distributed in soils of California and usually live as saprophytes on dead wood or other organic matter. More than 600 plant species have been listed as hosts of this pathogen. Armillaria is frequently associated with hardwood roots, especially oaks. Healthy oaks are quite resistant to the fungus. This resistance disappears, however, when trees are weakened, stressed, cut, or killed, and Armillaria may then rapidly

colonize and decompose roots and sometimes entire root systems. The organic material used as a source of nutrition is called a food base.

With a large food base to utilize, the fungus becomes aggressive and moves to the roots of nearby trees by means of root contacts and rhizomorphs. Rhizomorphs are structures that resemble black shoestrings and grow like roots through upper soil layers. The predominant method of tree to tree spread in California is via root contact.

Armillaria is capable of directly penetrating through the intact root bark of living trees and once it reaches the cambium it usually grows quite rapidly, producing a flat, white, leathery, fan-shaped mycelial mat. Rhizomorphs are often associated with the mat. If the fungus reaches the root collar it girdles the stem and kills the tree. After Armillaria successfully colonizes a root segment or root system, it continues to decay the wood and causes a white to yellowish, wet, stringy rot. This rot does not usually extend up the bole more than a few feet above the soil line.

Clusters of mushrooms may be found in the fall at the base of infected dead or dying trees and stumps. These mushrooms may also grow directly out of the soil near the food base. Spores produced by fruiting bodies are not an important source of new infections or long distance spread.

In California, this root disease often causes management problems in young plantations and campgrounds. Armillaria may kill conifer seedlings in plantations where oaks were eliminated during harvest or site preparation. Oak stumps and roots provide the needed food base. Regeneration losses will probably not become evident for at least 5 years after oaks are killed, but may then continue for 5-10 years. Seedling mortality does not usually extend beyond the influence or root zone of the infested oak. In other words, disease centers caused by Armillaria do not enlarge or persist for many decades as do those of root rots like Fomes annosus. The ultimate impact of this root disease is dependent upon the size, number, and distribution of food bases.

Large or vigorous trees may be infected, but not die. The fungus can decay structural roots without causing any obvious above-ground symptoms of disease. Such trees may eventually become susceptible to windthrow or failure and are of greatest concern in recreation areas.

Annosus Root Disease

Fomes annosus is a fungus that attacks a wide variety of woody plants. All western conifer species are susceptible. Madrone (Arbutus menziesii), and a few brush species (Arctostaphylos spp. and Artemisia tridenta) are occasional hosts. Other hardwood species are apparently not infected. The disease has been reported on all the National Forests in California, with incidence particularly high on true fir in northern California campgrounds.

During periods favorable to the fungus, fruiting bodies (conks) form in decayed stumps, under the bark of dead trees, or under the duff at the root collar. New infection centers begin by aerial spread of spores produced by the conks and subsequent colonization of freshly cut stump surfaces or wounds on living trees. The fungus then spreads through root contacts into the root systems of

adjacent live conifers. Local spread of the fungus from a stump typically results in the formation of a disease center, with dead trees in the center and fading trees on the margin. These centers usually continue to enlarge until they reach natural barriers such as stand openings or non-susceptible plants. The fungus may remain alive for as long as 50 years as a saprophyte in infected roots and stumps.

In pines, F. annosus grows through root cambial tissue to the root crown where it girdles and kills the trees. In less resinous species such as true firs, the fungus sometimes kills trees, but more frequently it is confined to the heartwood and inner sapwood of the larger roots where it causes a chronic butt and root decay and growth loss.

Red Ring Rot

Red ring rot, also called white pocket rot, is caused by a wood decay fungus, Phellinus (Fomes) pini, that attacks Douglas-firs, pines, true firs, hemlock, and rarely incense-cedar. It occurs throughout the coniferous forests of the world, and is the single most damaging heart rot organism in the West.

Red ring rot attacks young-growth as well as old-growth trees. It usually infects through branch stubs, and rarely through open wounds. Thus, this fungus may cause serious heart rot problems in managed stands of the future.

The perennial, woody fruiting bodies or conks that arise from the branch stubs or knots of living trees are the best indicators of decay. Sometimes only punky knots bearing the inner portion of the fruiting body remain on the stem. These punky knots may later be overgrown by new wood, becoming swollen knots that are the only symptom of decay. When conks or swollen knots are present, assume that advanced decay extends about 3-5 feet above and 5-7 feet below the indicator. If conks or swollen knots are visible along much of the stem, heart rot will be extensive.

Western Pine Beetle

The western pine beetle, Dendroctonus brevicomis, breeds in the main bole of living ponderosa and Coulter pine generally larger than about 8-10 inches dbh. Normally it breeds in trees weakened by such factors as drought, overstocking, root disease, dwarf mistletoe or fire.

Adult beetles emerge and attack trees continuously from spring through fall. Depending on the latitude and elevation, there can be from one to four generations per year. The generations are difficult to distinguish because the prolonged period of initial attack and re-emergence of parent females to establish additional broods causes considerable overlapping of the generations.

Initial attacks are made about mid-bole and subsequent attacks fill in above and below. Pheromones released during a successful attack attract other western pine beetles. Attacking beetles may spill over onto nearby apparently healthy trees and overwhelm them by sheer numbers. Pitch tubes and red boring dust are indications of successful attacks.

Adults bore a sinuous gallery pattern in the cambium and the female lays eggs in niches along the sides. The larvae feed in the inner bark for a short distance and then turn into the outer bark to complete development.

Bluestain fungi introduced during successful attacks probably contribute to the rapid mortality associated with bark beetle attacks.

Woodpeckers, predaceous beetles and low winter temperatures cause natural control. Silvicultural activities that result in rapid, vigorous tree growth increases tree resistance and prevents mortality. Individual high value trees undergoing a temporary reversible stress, such as drought, can be protected for up to a year by applying certain insecticides to the bole.

Pine Engravers

Pine engraver beetles, Ips spp., are common throughout Western North America. They most commonly attack freshly cut pine logs, green slash and breakage, as well as tops and limbs of living trees. Top-killing by engraver beetles may precede or occur in conjunction with attacks by Dendroctonus bark beetles. When suitable host material is plentiful, such as 8 inch diameter and larger slash or drought-stressed pines, large numbers of beetles may develop and aggressively attack healthy green pines nearby. Young pines from 2 to 8 inches in diameter and the tops of older trees are the host material most at risk. This is particularly true of densely stocked groups of trees. Fortunately, outbreaks are usually of short duration and seldom last more than one season.

Attacking adults may be found under the bark, typically constructing three or four egg galleries from a central nuptial chamber. These galleries run parallel with the wood grain and assume a Y or H pattern. The galleries are kept clear by the male adults and, consequently, the reddish boring dust accumulates in piles near the entrance holes. The dust is particulary visible on horizontal host material such as blowdown. On vertical trees it catches on bark flakes and crevices, and spider webs. Two to four generations can be expected per year - two or three summer generations following spring emergence of adults and possibly another that will overwinter as adults, either under the bark or in forest litter at the base of pine stumps or standing dead pines.